

The Level of Critical Thinking Ability of Students in the Learning by Using Adobe Animate Based Learning Media

Theofilus Gratiamus Gusemanto^{1,*} Warsono² L R Prakasiwi³ Zul Hidayatullah⁴

¹ *Master of Physics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Indonesia*

² *Department of Physics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Indonesia*

^{*}*Corresponding author. Email: fgusemanto08@gmail.com*

ABSTRACT

This study aims to determine the level of critical thinking ability of students in learning using adobe animate-based learning media. This research is a type of experimental research. The design in this study used a post-test control group design with simple random sampling technique. This research was implemented at SMAN 1 Banguntapan Yogyakarta. The sample in this research were students class X MIA 4 students as the experimental class and X MIA 3 students as the control class. The indicators of critical thinking ability tested are identifying concepts, clarifying concepts, problem solving, making general conclusions and analysing concept. The results showed that the ability of students in the experimental class was higher than that of the control class. This applies to all measured indicators of critical thinking. The average thinking ability of students in the experimental class is at a very high level while in the control class it is at a high level. The results of the analysis using the independent t test show that there is a significant difference in the critical thinking ability aspects of students in the experimental class with students in the control class.

Keywords: *Critical thinking ability, Media in learning, Adobe animate*

1. INTRODUCTION

Education is essential for life. Education plays a role in preparing quality human resources. Education guides the younger generation to become a better generation. Education makes students actively developed their potential that is useful for themselves, society and the nation. Education demands that technology be used in teaching and learning activities so that education can be adapted to developments in science and technology. Today's education is focused on learning to improve higher order thinking skills (HOTS) as a way to increase human resources [1]. Therefore, teaching and learning activities that are carried out must accommodate the achievement of this higher thinking ability.

Critical thinking ability are a part of HOTS. The ability to think critically is considered an ability needed by individuals in the 21st century, so that it becomes one of the benchmarks in the goals of

education in Indonesia based on the 2013 curriculum [2]. This capability has been considered a central and fundamental goal of education. Critical thinking ability is the ability to think in the form of reflective thinking to focus on what to believe and do when faced with a problem [3]. This ability makes a person able to be rational and choose the best alternative choice for him. In addition, instilling a habit of critical thinking in a person needs to be done so that they can observe various problems that occur in everyday life [4]. The ability to think critically is not just a hope of learning or a way of solving problems, but rather as a challenge to existing knowledge and looking for alternatives to build new knowledge.

The ability of critical thinking makes a person to think effectively which can assist him in making, evaluating and making decisions about what he believes or does. Students who get used to thinking critically will be trained in making decisions and making statements. These decisions and statements

are made based on logical and valid considerations so that they can be justified [5]. Students are said to have critical thinking ability when able to speak using appropriate and systematic reasons when solving a problem [6]. Students who have critical thinking ability are helped when making decisions in solving problems in their lives [7]. When we being critical, we can evaluate the results of the thought process to see how well a problem was solved [8]. These are the reason why critical thinking is too important for student. The ability to think critically is prepared as a basis or capital for students in dealing with and dealing with rapid changes in technology that are being faced. However, critical thinking ability is not innate but when practiced or applied through the learning process [9]. So that, it must be practiced and improved regularly.

Physics learning can be used to train and develop in critical thinking ability. For, being critical is main gol of physics learning [10]. Physics learning becomes an instrument to develop thinking ability which are useful in developing this ability. When the students learn the concept of physics, they are actually studying natural phenomena that happened around them. The phenomena that students find in the life around them can be an instrument of increasing this ability [3]. Planning learning activities based on critical thinking ability can be applied in the learning process. Students are trained to formulate questions and problems, collect relevant information, take problem-solving actions, and communicate results and solutions [11]. This learning steps make their critical thinking ability more trained and developed.

However, the spread of the corona virus in Indonesia, especially in Special Region of Yogyakarta province, has affected the learning process be stagnated at school. Local governments are forced to make the regulation for online learning system. This is in accordance with the Special Region of Yogyakarta Governor Circular letter, Number 443/2 29 about educational activities in the emergency response period for the Covid-19 disaster in educational environment in the Special Region of Yogyakarta. This rule consists of 5 points, one of which regulates online learning. Learning process must be going on even during the COVID 19 pandemic. Teachers are required to provide quality learning so that students are not retarded in learning. This makes teachers to look for ways in order to learning process is going on in their school. Online learning is the most possible alternative so that students do not miss the subject matter [12]. During online learning, teachers are required to catch up with material lags due to holidays at the beginning of the

pandemic. Beside it, the learning process that teachers provided must be able to accommodate the development and improvement of students' in critical thinking ability.

However, the physics learning process during the Covid-19 pandemic was dominated by the lecture method. This learning method cannot make students actively participate in learning. This causes less balance in the abilities of students. This learning method make the students become difficult to develop of their critical thinking ability [13]. In online learning, teachers do not provide opportunities for students to express their opinions. So, this fact make the students become lazy to practice in critical thinking [14]. Monotonous in learning, less variation, and no direct interaction with friends and teachers causes boredom for students. Boredom in learning can cause the concentration and absorption of the essence of the material to decrease. This saturation makes the critical thinking ability of students difficult to use properly [15]. Thus complicating the process of developing students' critical thinking ability.

In order for physics learning to train and develop critical thinking ability, attractive learning media are needed. An attractive learning media makes it easier to improve critical thinking ability [16]. The use of media is important in the teaching and learning activities [17]. For a teacher, the function of media is like a hoe for a farmer. The media of learning is something that must be used in achieving learning objectives [18]. Learning media is an instrumen to sustain learning activities so that the delivery of subject matter becomes more interesting. The use of learning media also facilitates learning activities and increases the efficiency of teaching and learning. The learning media makes it easier for teachers to provide and present material in the teaching and learning activities so that students can more easily understand and understand the material provided by the teacher [19]. Learning media can stimulate the mind so it can improve students' critical thinking ability [2]. Media in the learning process becomes important to use in efforts to improve and develop critical thinking ability.

The Learning Adobe Animate based media is an alternative that can be used in making the learning process interesting. Adobe animate is an application that is used widely in the creative industry for developing attractive projects that integrate video, sound, graphics, and animation. This application can be used to create interactive animations and simulations. This application also can be used to create websites, web-based applications, interactive

applications and videos [20]. Adobe Animate is in great demand because of its reliability in doing everything related to multimedia. Adobe animate can produce graphic and animation assets, to build innovation and immersive websites, to create standalone applications for the desktop, or to create applications for distribution to mobile devices running on android or IOS systems. Adobe animate can design HTML5 animation, animated advertising media, animation videos, learning media and game [21]. In the adobe animate application, you can create objects as you wish, both images, sound and motion animations. So that teachers can make the learning process more interesting and challenging.

This paper contains the level of critical thinking ability seen from the use of adobe animate-based media in learning process. Adobe animate-based learning media are applied or used in the learning process. With characteristics and advantages that can integrate video, graphics, animation and simulation, this learning media can train and develop students' critical thinking ability. So that the level of critical thinking ability of students can increase.

2. RESEARCH METHOD

This study uses a quantitative approach. This type of study is experimental. The purpose of this study was to determine the level of critical thinking ability of students after learning with Adobe Animate based learning media.

The subjects in this study were all class X students of State Senior High School 1 Banguntapan Yogyakarta for the 2019/2020 academic year. Simple random sampling technique was used in sampling in this study. The sample in this research were 35 students of Class X MIA 4 as the experimental class and 35 students of Class X MIA 3 as the control class. The research design used was Posttest Only Control Group Design according to Table 1.

Table 1. Research design.

Type Class	Treatment	Posttest
Experiment	X	O ₁
Control	-	O ₂

The process of testing the hypothesis in this study used the independent t test. This hypothesis testing to determine the differences in critical thinking ability in table 2, the level of critical thinking ability of

between the experimental class and the control class. Learning in the experimental class uses Adobe animate-based learning media and the control class not uses this media. There are 5 indicators of critical thinking ability used in this research, namely identifying concepts, clarifying concepts, problem solving, making general conclusions and analysing concepts. To determine the level of critical thinking ability of students, tests were carried out. The results obtained on the test were analysed using equation (1):

$$\frac{x}{x_{max}} \times 100 \tag{1}$$

Information: x is the score obtained and x_{max} is the maximum score.

The results of the calculation of the level of critical thinking ability will be interpreted in Table 2 to determine the level of critical thinking ability of students.

Table 2. Levels of students' critical thinking ability.

Percentage (%)	Levels of critical thinking ability
80 < Score ≤ 100	Very high
60 < Score ≤ 80	High
40 < Score ≤ 60	Moderat
20 < Score ≤ 40	Low
0 ≤ Score ≤ 20	Very low

3. RESULT AND DISCUSSION

The aspect measured in this study is the level of critical thinking ability of students who get learning using adobe animate-based media. In addition, the level of critical thinking ability of students who don't get learning with this media is also measured as a comparison. There are 5 indicators of critical thinking ability used as a reference, namely: identifying concepts, clarifying concepts, problem solving, making general conclusions and analysing concepts. After the learning process is complete an evaluation process is carried out. The scores obtained by students in the test will be used in seeing students' critical thinking ability.

The test results show that the average score for the experimental class is 81. This shows that the level of critical thinking ability of students in the experimental class is at a very high level. While the average score in the control class is 71. If interpreted

Table 3. Score of critical thinking ability

Class Type	Number of students	Score of critical thinking ability		
		Lowest	Highest	Average
Experiment	35	64.3	93	81
Control	35	21.4	86	70

students in the control class is at a high level. When viewed based on the average score, it shows that the critical thinking ability of students in the experimental class are higher.

Table 3 shows that the highest score in the experimental class is higher than the highest score in the control class. The critical thinking ability of students who have the highest score in the experimental class and control class are at the same level, which is very high. However, if it is viewed from the students who have the lowest score, the students' critical thinking ability in the experimental class is the lowest at a high level. Meanwhile, the control class is at a low level. It can be said that the level of critical thinking ability of students who use adobe animate-based learning media is higher than those who do not use this media.

Learning using adobe animate based media can attract the attention of students. In this learning media there are animations and interactive simulations. Animations displayed in the learning process can help students practice their critical thinking ability [22]. The critical thinking ability of students who use adobe animate-based media are higher than students who do not use this media. In detail, the comparison of students'critical thinking ability is presented in figure 1.

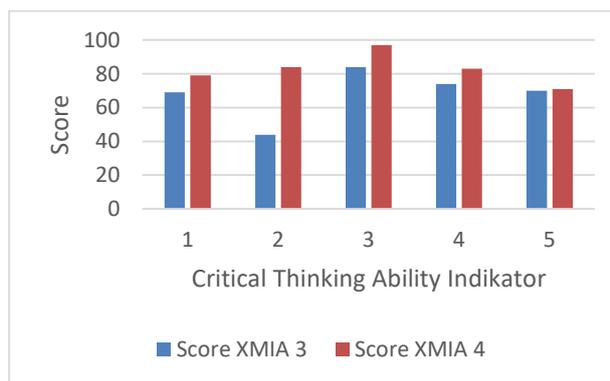


Figure 1. Comparison of critical thinking ability per indicator

Information:

- 1: Identifying concepts
- 2: Clarifying concepts
- 3: Problem solving

- 4 : Making General Conclusions
- 5 : Analysing Concepts

Figure 1 shows that students of class X MIA 4 as the experimental class have a higher average score than students of class X MIA 3 as the control class for all aspects. A very big difference occurred in the aspect of clarifying the concept, namely a score of 84 in experimental class and a score of 44 in control class.

Students in experimental class are very fast and active in explaining and clarifying the concepts of simple harmonic vibrations. The animations and simulations contained in this adobe animate based media make students more active in following the teaching and learning process.

They have the opportunity to find answers with broader insight and knowledge so that their critical thinking ability are increasingly developing [23]. They are trained to think and find their own answers to the questions contained in this adobe animate based media. The opportunity to seek answers with this insight opened their minds even more. This is what makes their critical thinking ability higher than those who do not use this media. Students who use adobe animate based learning media get higher test results than students who don't use this media. The test results are interpreted in table 2 to see the comparison of the level of critical thinking ability of students between the two classes being tested. The results of these interpretations are shown in table 4.

Table 4. Distribution of the number of students per level

Level of Critical thinking ability	Class	
	Experiment	Control
Very High	18 students	10 students
High	17 students	15 students
Moderate	-	6 students
Low	-	4 students
Very Low	-	-

Table 5. T-Test results related to differences in critical thinking abilities

Test	Df	Mean difference	Std. error differences	Score t-test	Sig.(2-Tailed)
Experiment-Control	68	10,971	3,329	-3,295	0.002

Table 4 shows that the test results of students in the experimental class are at very high and high levels. While the test results of students in the experimental class were spread over 4 categories: very high, high, moderate and low. The moderate and low levels in the control class indicate that adobe animate-based media in the learning process needs to be used in an effort to improve critical thinking ability.

To prove that there are differences in critical thinking ability between students in these two classes, it is carried out by statistical tests. The statistical test used was the independent t test. Before do the statistical test, the normality and homogeneity tests were carried out as prerequisites for conducting hypothesis testing. The results of the normality and homogeneity tests show that this data is normally homogeneous. Furthermore, statistical tests are carried out and get the results as shown in Table 5.

Table 5 hypothesis testing shows that the significance value is $0.002 < 0.05$. This proves that there is a difference in critical thinking between the students in the experimental class and control class. The result of this hypothesis testing also shows the difference effect on students by using and not using adobe animate based media.

Using adobe animate based media has good effect on students in away trained and develop in critical thinking ability. Students in experimental class become more actively and participate in learning process because of using adobe animate based media. Students who use adobe animate based learning media will have the opportunity to develop their critical thinking ability.

Adobe animate based media is a new alternative in education that can help improve the learning process. This media is often used in designing and creating animations and simulations [24]. Animations and simulations can aid to improve students' abilities, including critical thinking ability. Available animations in this learning media foster and stimulate the curiosity of students. This curiosity leads students to make an experiment, so that all theories are acceptable and reasonable [25]. In addition, available

animations in the learning media stimulated students' curiosity.

This curiosity leads to ask questions and looking for answers. This learning process pushed ahead the student critical thinking ability increasingly and progressively [26]. Using animation leads the teachers become more creative in their explanation something. Teacher explanations become more real and attractive because of using animation as well. For, give more concreat in explanation will be easier for students to understand. This way can support students become increasingly in critical thinking [27]. Learning by using media that contains animation in it is very well used in the teaching and learning activities. This animation leads students to improve their critical thinking ability in solving all problem that exist in the learning process [23].

Using adobe animate based media in learning, there are simulations of concepts and phenomena related to simple harmonic vibrations on springs. The simulations contained in adobe animate-based learning media aid students to be participated in identifying and clarifying cases. Students are trained to analysed the cases in the simulation. The ability of students to solve cases and make conclusions can also be trained and improved so that, can make conclusion correctly and precisely. These thinks allow students to develop critical thinking ability. A number of questions in student worksheets at interactive simulations help students to practice their logical thinking ability in solving physics problems [22]. Worksheet in the simulation proved to be influential in the problem solving process. The use of simulations in learning activities can help someone make considerations to distinguish and find similarities in the cases presented. These considerations train his critical thinking ability [28]. Interactive simulation helps a person visualize problems and their solutions. The use of interactive simulations can further improve logical inference ability and the ability to draw conclusions [29]. This make the critical thinking ability of students become higher and develop.

4. CONCLUSION

Using Adobe Animate-based media in learning process can help students improve in critical thinking. Students that using adobe animate is more increasingly in critical thinking ability than students that not using this media. The results of the hypothesis test show that there are differences in the critical thinking ability aspects of students in the experimental class with students in the control class. Students' critical thinking ability in the experimental class are at a very high level. Meanwhile, the critical thinking ability of students in the control class are only at a high level.

REFERENCES

- [1] R. Zulmaulida, Wahyudin, J.A. Dahlan, Watson-Glaser's critical thinking skills, in: *Journal of Physics: Conference Series*, vol. 1028, IOP Publishing, Makasar, 2018, pp. 1-6. DOI: <https://doi.org/10.1088/17426596/1028/1/012094>
- [2] D.S. Sari, K.H. Sugiyarto, Pengembangan Multimedia Berbasis Masalah Untuk Meningkatkan Motivasi Belajar dan Kemampuan Berpikir Kritis Siswa, *Jurnal Inovasi Pendidikan*, 1(2) (2015) 153-166. DOI: <https://doi.org/10.21831/jipi.v1i2.7501>
- [3] Syarifah, Y. Sumardi, Pengembangan Model Pembelajaran Malcolm's Modeling untuk Meningkatkan Keterampilan Berpikir Kritis dan Motivasi Belajar Siswa, *Jurnal Inovasi Pendidikan IPA* 1(2) (2015) 237-247. DOI: <https://doi.org/10.21831/jipi.v1i2.75010>
- [4] C. Novtiar, U. Aripin, Meningkatkan Kemampuan Berpikir Kritis Matematis dan Kepercayaan Diri Siswa SMP Melalui Pendekatan Open Ended, *Jurnal Prisma* 6(2) (2017) 119-131. DOI: <https://doi.org/10.35194/jp.v6i2.122>.
- [5] F. Fakhriyah, Penerapan Problem Based Learning dalam Upaya Mengembangkan Kemampuan Berpikir Kritis Mahasiswa, *Jurnal Pendidikan IPA Indonesia* 3(1) (2014) 95-101. DOI: <https://doi.org/10.15294/jipi.v3i1.2906>
- [6] A.H. Ngurahrai, S.D. Farmaryanti, Nurhidayati., Media Pembelajaran Materi Momentum dan Impuls Berbasis Mobile learning untuk Meningkatkan Kemampuan Berpikir Kritis Siswa, *Berkala Ilmiah Pendidikan Fisika* 7(1) (2019) 62-70. DOI: <http://dx.doi.org/10.20527/bipf.v7i1.5440>
- [7] N.L. Dewi, Z. Prasetyo, Pengembangan Instrumen Penilaian IPA untuk Memetakan Critical Thinking dan Practical Skill Peserta Didik SMP, *Jurnal Inovasi Pendidikan IPA* 2(2) (2016) 213-222. DOI: <https://doi.org/10.21831/jipi.v2i2.11963>
- [8] N. Dimmitt, The power of project based learning: Experiential education to develop critical thinking skills for university students, in: *CBU International Conference Proceedings*, vol. 5, CBU Publishing, Prague, 2017, pp. 575-579. DOI: <http://dx.doi.org/10.12955/cbup.v5.98>
- [9] S. Nurazizah, P. Sinaga, A. Jauhari, Profil Kemampuan Kognitif dan Keterampilan Berpikir Kritis Siswa SMA pada Materi Usaha dan Energi, *Jurnal Penelitian & Pengembangan Pendidikan Fisika* 3(2) (2017) 197-202. DOI: <https://doi.org/10.21009/1.03211>
- [10] N.G. Holmes, C.E. Wieman, D.A. Bonn, Teaching critical thinking, in: *Proceedings of the National Academy of Sciences of the United States of America*, vol. 112, PNAS Publishing, New York, 2015, pp. 11199-11204. DOI: <https://doi.org/10.1073/pnas.1505329112>
- [11] D.A. Uswatun, E. Rohaeti, Perangkat Pembelajaran IPA Berbasis Inkuiri untuk Meningkatkan Critical Thinking Skills dan Scientific Attitude Siswa, *Jurnal Inovasi Pendidikan IPA* 1(2) (2015) 138-152. DOI: <https://doi.org/10.21831/jipi.v1i2.7498>
- [12] Firman, S. R. Rahman, Pembelajaran Online di Tengah Pandemi Covid-19, *Indonesian Journal of Educational Science* 2(2) (2020) 81-89. DOI: <https://doi.org/10.31605/ijes.v2i2.659>
- [13] A. Malik, V. Oktaviani, W. Handayani, M.M. Chusni, Penerapan Model Process Oriented Guided Inquiry Learning (POGIL) untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik, *Jurnal Penelitian & Pengembangan Pendidikan Fisika (JPPPF)* 3(2) (2017) 127-136. DOI: <https://doi.org/10.21009/1.03202>
- [14] B. Latifa, N. Verawati, A. Harjono, Pengaruh Model Learning Cycle 5e (Engage, Explore, Explain, Elaboration, & Evaluate) terhadap Kemampuan Berpikir Kritis Peserta Didik Kelas

- X MAN 1 Mataram, *Jurnal Pendidikan Fisika dan Teknologi* 3(1) (2017). DOI: <https://dx.doi.org/10.29303/jpft.v3i1.325>
- [15] L. Handayani, Keuntungan, Kendala dan Solusi Pembelajaran Online Selama Pandemi Covid-19 : Studi Ekloratif di SMPN 3 Bae Kudus, *Journal Industrial Engineering & Management Research (Jiemar)* 1(2) (2020) 15-23. DOI: <https://doi.org/10.7777/jiemar.v1i2.36>.
- [16] A.E. Damayanti, H. Kuswanto, The use of android-assisted comics to enhance students' critical thinking skill, in: *Journal of Physics: Conference Series*, vol. 1440, IOP Publishing, Bristol, 2020, 1-7. DOI: <https://doi.org/10.1088/1742-6596/1440/1/012055>
- [17] I. Ichsan, A. Dewi, F. Hermawati, E. Iriani,, Pembelajaran IPA dan Lingkungan: Analisis Kebutuhan Media Pembelajaran pada SD, SMP, SMA di Tambun Selatan, Bekasi, *JIPVA Jurnal Pendidikan IPA Veteran* 2(2) (2018) 131-140. DOI: <https://doi.org/10.31331/jipva.v2i2.682>
- [18] I.G.M. Adnyana, W. Suyanto, Penggunaan EFI scanner sebagai media pembelajaran untuk meningkatkan minat, motivasi, dan prestasi belajar siswa, *Jurnal Pendidikan Vokasi* 3(2) (2013) 192-209. DOI: <https://doi.org/10.21831/jpv.v3i2.1601>
- [19] A.R. Aththibby, M.B. Salim, Pengembangan Media Pembelajaran Fisika Berbasis Animasi Flash Topik Bahasan Usaha dan Energi, *Jurnal Pendidikan Fisika (JPF) UM Metro* 3(2) (2015) 25-33. DOI: <http://dx.doi.org/10.24127/jpf.v3i2.238>
- [20] T. Green, J. Labrecque, *Beginning Adobe Animate CC: Learn to Efficiently Create and Deploy Animated and Interactive Content*, Apress, 2017.
- [21] R. Chun, *Adobe Animate CC Classroom in a Book*, Printed and Bound in the United State of America, 2018.
- [22] S. Husein, L. Herayanti, Gunawan, Pengaruh Penggunaan Multimedia Interaktif Terhadap Penguasaan Konsep dan Keterampilan Berpikir Kritis Siswa pada Materi Suhu Dan Kalor, *Jurnal Pendidikan Fisika dan Teknologi* 1(3) (2015) 221-225. DOI: <http://dx.doi.org/10.29303/jpft.v1i3.262>
- [23] S. Wahyuni, A. Emda, H. Zakiyah, Pengaruh Penggunaan Media Animasi pada Materi Larutan Elektrolit dan Nonelektrolit Terhadap Kemampuan Berfikir Kritis Siswa SMA, (*JUPI Jurnal IPA dan Pembelajaran IPA* 2(1) (2018) 21-28. DOI: <https://doi.org/10.24815/jipi.v2i1.10743>
- [24] F.S. Abdullah, T.N.H. Yuniarta, Pengembangan Media Pembelajaran Matematika Trigo Fun Berbasis Game Edukasi Menggunakan Adobe Animate Pada Materi Trigonometri, *AKSIOMA : Jurnal Pendidikan Matematika* 7(3) (2018) 434-443. DOI: <http://dx.doi.org/10.24127/ajpm.v7i3.1586>
- [25] H. Munandar, Sutrio, M. Taufik, Pengaruh Model Pembelajaran Berbasis Masalah Berbantuan Media Animasi Terhadap Kemampuan Berpikir Kritis dan Hasil Belajar Fisika Siswa SMAN 5 Mataram Tahun Ajaran 2016/2017, *Jurnal Pendidikan Fisika dan Teknologi* 4(1) (2018) 111-118. DOI: <https://doi.org/10.29303/jpft.v4i1.526>
- [26] U. Hasanah, L. Nulhakim, Pengembangan Media Pembelajaran Film Animasi Sebagai Media Pembelajaran Konsep Fotosintesis, *Jurnal Penelitian dan Pembelajaran IPA* 1(1) (2015) 91-106. DOI: <http://dx.doi.org/10.30870/jppi.v1i1.283>
- [27] F. Falah, M. Komaro, Y. Yayat, Penggunaan Multimedia Animasi Untuk Meningkatkan Kemampuan Berpikir Kritis dalam Pembelajaran Materi Bidang Geser, *Journal of Mechanical Engineering Education* 3(2) (2016) 159-166. DOI: <https://doi.org/10.17509/jmee.v3i2.4545>
- [28] L. Herayanti, Habibi, Pembelajaran Berbasis Masalah Berbantuan Simulasi Komputer untuk Meningkatkan Keterampilan Berpikir Kritis Calon Guru Fisika, *Jurnal Pendidikan Fisika dan Teknologi* 1(1) (2015) 61-66. DOI: <http://dx.doi.org/10.29303/jpft.v1i1.236>
- [29] Gunawan, A. Harjono, Sutrio, Multimedia Interaktif dalam Pembelajaran Konsep Listrik Bagi Calon Guru, *Jurnal Pendidikan Fisika dan Teknologi* 1(1) (2015) 9-14. DOI: <http://dx.doi.org/10.29303/jpft.v1i1.230>